FABRIC DEVELOPMENT WITH NEAREST-NEIGHBOR INTERACTION AND DYNAMIC RECRYSTALLIZATION

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ABSTRACT

Polycrystals undergoing ductile deformation develop lattice-preferred orientation (fabric) as a result of intra-crystalline slip. A consequence of fabric development is that bulk physical properties become anisotropic. Fabric development and macroscopic deformation are studied by examining three effects: nearest-neighbor interaction (NNI) among crystals, polygonization and migration recrystallization. The effects of NNI are modeled by arranging the crystals on a 3-D cubic grid, and assigning 6 neighbors to each crystal. The ``strength'' of interaction can vary, from no interaction (homogeneous stress) to ``strong'' interaction (significant stress redistribution). Increasing the NNI leads to a more homogeneous strain. Fabric varies in both strength and symmetry at a given bulk strain, depending on the strength of NNI. For a prescribed fabric the strain rate increases as the NNI increases. Recrystallization is modeled from energy balance considerations, and polygonization is formulated in terms of stress differences. Both processes require knowledge of dislocation density, which is calculated in the model as a function of crystal strain and grain size, both of which vary with time. Models of fabric development in ice that include NNI lead to more realistic fabric evolution than models with homogeneous stress. However, available data on fabric evolution are inadequate to determine quantitatively the strength of NNI acting in ice.

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